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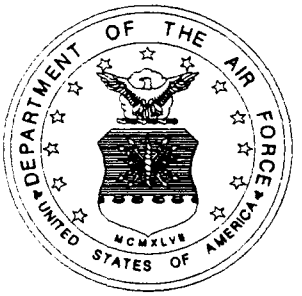
ETL 91-7
SUPERCEDES ETL 88-5
21 AUGUST 1991

ENGINEERING TECHNICAL LETTER

CHLOROFLUOROCARBON (CFC) LIMITATION IN HEATING, VENTILATING & AIR CONDITIONING (HVAC) SYSTEMS



OFFICE of THE CIVIL ENGINEER
DIRECTORATE of MILITARY CONSTRUCTION
ENGINEERING DIVISION

21 AUG 1991

HQ USAF/CEC

Engineering Technical Letter (ETL) 91- 7 , Chlorofluorocarbon (CFC) Limitation in Heating, Ventilating and Air-Conditioning (HVAC) Systems. (Supersedes ETL 88-8, same subject, 4 Oct 88)

Distribution List.

1. Purpose:

a. This ETL supercedes ETL 88-8 dated 4 October 1988.

b. This ETL provides guidance to reduce Air Force dependence on regulated CFCs as refrigerants in HVAC systems. Escalating taxes on CFCs use and possible complete phase-out of production of these regulated CFCs (CFC-11, CFC-12, CFC-113, CFC-114, CFC-115, and refrigerant mixtures of these regulated CFCs such as CFC-500, CFC-501, and CFC-502) by the end of 1999 necessitates strategic planning immediately to avoid vulnerability in the immediate and long-term future. This will result in a corresponding reduction of availability and increase in cost. Recycling and recovery of these regulated CFCs will become mandatory to prevent intentional venting, and to preserve and reuse CFCs currently in use to service existing installed equipment. The venting prohibition is to go into effect 1 July 1992. In accordance with Msg 131445Z SEP 90, HQ USAF/LEED, the continued installation of HVAC systems using regulated CFCs is unacceptable environmentally and construction contracts shall not be awarded utilizing CFC-11 or CFC-12.

c. For new HVAC equipment, alternatives to CFC-11 and CFC-12 have been developed and are now available. Acceptable alternative refrigerants include, but are not limited to HCFC-22, HCFC-123, and HFC-134a.

d. For existing HVAC equipment installations, appropriate strategies include:

(1) Containment of existing refrigerants through improved O&M procedures to reduce leaks and emissions during routine handling, servicing, overhaul, and operations. Use of refrigerant pump-out/recovery equipment, retrofit with efficient purge systems on low pressure chillers, identifying and correcting leaks, reclaiming contaminated or otherwise unusable refrigerant, monitoring usage, and general conservation practices shall be used.

(2) Conversion of existing HVAC equipment, typically centrifugal chillers, to operate on the alternative refrigerants should be undertaken only when economically or operationally appropriate. An "engineered conversion" should be made in consultation with the original equipment manufacturer to ascertain the effect on capacity and energy usage, and to determine the proper conversion program to minimize degradation in capacity and increase in energy consumption. Consideration should be given to supplementing lost capacity with an additional chiller by comparing the cost of this approach to the cost of the various conversion options.

(3) Change-Out or replacement of existing HVAC equipment to new equipment which operates on one of the alternative refrigerants should be considered when the existing equipment:

(a) reaches the end of its useful mechanical life and overhaul is deemed not cost effective, or

(b) can no longer meet mission requirements, or

(c) can not be economically converted to operate on an alternative refrigerant or conversion is otherwise not feasible or cost effective.

2. Effective Date: This ETL is to be implemented as of the date of this letter.

3. Referenced Publications: Applicable referenced publications are as follows:

a. AFR 88-15, Criteria and Standards for Air Force Construction.

b. ETL 88-4, Reliability and Maintainability (R&M) Design Checklist, 24 June 1988.

c. HQ USAF/LEED Message 131445Z Sep 90, Limitation of Chlorofluorocarbons and Halons.

d. Clean Air Act Amendments of 1990 (Public Law 101-549).

e. BSR/ASHRAE Standard 15-1989R, "Safety Code for Mechanical Refrigeration".

4. Description/Implementation: This criteria requires immediate implementation to reduce or eliminate Air Force dependence on CFCs for new HVAC equipment installations and to reduce and minimize Air Force CFC emissions in the routine operation, maintenance, and service of the existing inventory of installed HVAC systems. Currently, HVAC products using HCFC-22, HCFC-123, and HFC-134a are competitively available and provide an immediately available

solution to reduce or eliminate our dependence on CFCs for new equipment installations. Conservation of CFCs through improved O&M procedures, recovery of refrigerants, and recycling, will reduce and minimize emissions and help to prolong the useful operational life of installed HVAC systems. This ETL limits the use of CFCs in Air Force design and construction (MILCON, NAF and O&M) programs to non-regulated compounds as follows:

a. New mechanical HVAC refrigeration equipment shall use HCFC-22, HCFC-123, or HFC-134a or other available substances (except no CFCs) permitted under Section VI of the Clean Air Act.

b. For repair by replacement projects involving the complete refrigerant side of existing equipment, the replacement equipment shall use HCFC-22, HCFC-123, or HFC-134a or other available substances permitted beyond the year 2020 under Section VI of the Clean Air Act.

c. Equipment room installation of new, replacement, or converted HVAC equipment shall be in accordance with the recommendations of ASHRAE Standard 15R to minimize and protect against exposure to high concentrations of refrigerant vapor. Key elements of those recommendations are:

(1) Use a refrigerant sensor capable of monitoring the specific refrigerant concentration level.

(2) Use an alarm activated at a level not greater than the Allowable Exposure Limit (AEL) for the specific refrigerant used.

(3) Use mechanical equipment room ventilation rates sized per ASHRAE Standard 15R.

(4) Provide at least one approved self-contained breathing apparatus located convenient to the equipment room.

(5) Pipe the rupture member and purge discharge to the outdoors.

d. In addition to the recommendations of ASHRAE Standard 15R, the following practices will further contribute to an acceptable chiller equipment room environment and will conserve and contain refrigerant:

(1) Replace purge units on all low-pressure chillers which are over two years old with new high efficiency purge units to significantly reduce chiller refrigerant loss during operation and while idle.

(2) Use pump-out units to recover, recycle, and contain refrigerant liquid and vapor during servicing and overhaul to prevent loss and escape into the equipment room.

e. Purge System Specification: The following description of the purge system, for a centrifugal chiller using a low pressure refrigerant, shall be used in specifications to obtain a purge system with minimum standards of efficiency:

(1) The manufacturers of low pressure machines must provide a separate purge system that operates independently of the unit and can be operated while the chilled water pump is shutdown. No external water cooling source is to be required.

(2) If the purge unit cannot operate when the chiller is off, a positive pressure device (such as a belly heater) shall be provided on the evaporator to raise the pressure of the bundle above atmospheric pressure when the machine is off, This will prevent non-condensibles from entering the machine.

(3) Any excess purge requirement will enable a fault indication light at the purge and a contact closure will be provided for remote annunciation.

(4) The unit indication shall include:

(a) Lights indicating condenser running, fault indication and service operation.

(b) Elapsed time meter (monitor amount of leak rate).

(5) At standard operating conditions and with a condensing refrigerant temperature less than 80 degrees Fahrenheit, the purge exhaust must be rated for no more than 0.75 to 1.0 pound of refrigerant per one pound of non-condensibles.

f. Specifications shall be written to avoid restrictions on the specific type of refrigerant (except no CFCs) to encourage competitive bidding of available product offerings.

5. Exceptions to Policy:

a. New absorption equipment or replacing existing equipment with absorption equipment.

b. For large tonnage units (typically over 1200 tons), equipment in these size ranges which use HCFC-22, HCFC-123, or HFC-134a may not be commercially available by a minimum of two suppliers with adequate operational experience. Consider the installation of multiple smaller units using the acceptable refrigerants or using absorption equipment. All available equipment types (reciprocating, scroll, helical screw, absorption and centrifugal) must be evaluated in making this decision.

e. Point of contact for design issues (MILCON and NAF) is Mr. Jerry D. Williams, AF/CECE DSN 297-6237 or commercial (202) 767-6237; for O&M issues other than design, the contact is Mr. Quinn Hart, AFCESA/ENM, DSN 523-6346, or commercial (904) 283-6346.

FOR THE CHIEF OF STAFF

2 Atch
1. Definitions
2. Distribution List

DEFINITIONS

1. The following definitions for reclaim, recovery, and recycle pertain to the handling and treatment of refrigerants used in air conditioning and refrigeration equipment. These definitions are from the ASHRAE Proposed Guideline GPC-3P, "Guideline for Reducing Emission of Fully Halogenated Chlorofluorocarbon (CFC) Refrigerants in Refrigeration, Air Conditioning Equipment and Applications", June 1989. They are equally applicable to the handling and processing of other refrigerants such as HCFCs and HFCs. Included is the definition for purge which relates to maintaining refrigerant operating quality in chillers. All refrigerants, regardless of type, should be handled in an environmentally responsible manner and should be conserved for reuse or proper disposal. By 1 July 1992, Provisions under the new Clean Air Act will make it unlawful to knowingly vent or otherwise release controlled refrigerants into the environment.

2. Reclaiming Refrigerant:

a. To reprocess refrigerant to new product standards. This may require chemical analysis of the contaminated refrigerant to determine that the appropriate specifications are met. This term usually implies the use of processes or procedures available only at a refrigerant reprocessing or manufacturing facility.

b. During use in an air conditioning system, refrigerants become contaminated over time. Such contamination reduces the efficiency of the refrigerant and its effectiveness as a heat transfer working fluid. The degree and type of contamination determines if the refrigerant should be "reclaimed" or "recycled" (see definition below) to restore the refrigerant to the acceptable standard for reuse. Severely contaminated refrigerant typical of refrigerants which have been exposed to a major chiller failure, motor burn-out, etc., must normally be "reclaimed" using a multi-stage distillation process which requires the refrigerant be sent to a commercial reclamation facility for processing. The Air Conditioning and Refrigeration Institute (ARI) has established ARI Standard 700 as the standard for determining the quality of reclaimed refrigerant. ARI Standard 700 is designed to restore refrigerant to "like new" quality so it may be resold in the market place.

3. Recovery of Refrigerant: The process of removing and storing refrigerant from an air conditioning system so the product can be serviced, maintained, or overhauled without the loss of its refrigerant charge to the atmosphere. The recovery process typically involves the connection of an evacuation/pump-out unit which will remove refrigerant liquid and most of the refrigerant vapor into temporary storage tanks. The quality of the

evacuation/pump-out unit and its ability to draw a deep vacuum on the air conditioning equipment determines the degree of refrigerant removal which can be achieved. Lesser quality units leave a significant amount of refrigerant vapor in the unit which can subsequently escape to the atmosphere.

4. Recycling Refrigerant:

a. To clean refrigerant for reuse by oil separation and single or multiple passes through moisture absorption devices, such as replaceable core filter-driers. This term usually implies procedures implemented at the field job site or at a local service shop.

b. Not all refrigerant which has been contaminated needs to be commercially "reclaimed" [see definition above]. In most cases, contamination due to normal use is mild, consisting of entrained oil and some moisture/water vapor. Normal contaminants such as these can be effectively removed using field recycling devices, which clean the refrigerant and separate the refrigerant from entrained oil. Although not considered "like new" per ARI 700, recycled refrigerant has significantly improved operating performance compared to contaminated refrigerant. Recycling devices are often incorporated as optional features of Recovery/Pump-out units thus allowing for both the recovery and the recycling of the refrigerant when servicing, maintaining, or overhauling a piece of air conditioning equipment.

5. Purging:

a. To remove non-condensible contaminants, air, and water vapor from low pressure air conditioning equipment during normal equipment operation.

b. Purging applies to air conditioning chillers which use low pressure type refrigerants. These refrigerants are typically CFC-11 and HCFC-123. Because these are low pressure refrigerants, during operation and at certain times when the chiller is idle, the chiller may exist in a state of vacuum. This can cause air, water vapor, and other non-condensibles to enter the chiller which consequently degrades performance. Purge units are used on these chillers to remove these products from the machine and maintain the high level of performance of the chiller. In the past the process of purging involved the removal of the purged products but in addition, resulted in the loss of some refrigerant. Inefficient purge designs of the past could result in the chiller losing 10 percent or more of its operating refrigerant charge during a typical year of use. Currently, new high efficiency purge designs are available for retrofit on older model centrifugal chillers which reduce refrigerant losses during the purge operation by over 90% compared to purge designs of the past.

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ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
82-2	Energy Efficient Equipment	10 Nov 82
83-1	Design of Control Systems for HVAC	16 Feb 83
	Change No. 1 to ETL 83-1, U.S. Air Force Stndardized Heating, Ventilating & Air Conditioning (HVAC) Control Systems	22 Jul 87
83-3	Interior Wiring Systems, AFM 88-15 Para 7-3	2 Mar 83
83-4	EMCS Data Transmission Media (DTM) Considerations	3 Apr 83
83-7	Plumbing, AFM 88-8, Chapter 4	30 Aug 83
83-8	Use of Air-to-Air Unitary Heat Pumps	15 Sep 83
83-9	Insulation	14 Nov 83
84-2	Computer Energy Analysis	27 Mar 84
	Change 1 Ref: HQ USAF/LEEEU Msg 031600Z MAY 84	1 Jun 84
84-7	MCP Energy Conservation Investment Program (ECIP)	13 Jun 84
84-10	Air Force Building Construction and the Use of Termiticides	1 Aug 84
86-2	Energy Management and Control Systems (EMCS)	5 Feb 86
86-4	Paints and Protective Coatings	12 May 86
86-5	Fuels Use Criteria for Air Force Construction	22 May 86
86-8	Aqueous Film Forming Foam Waste Discharge Retention and Disposal	4 Jun 86
86-9	Lodging Facility Design Guide	4 Jun 86
86-10	Antiterrorism Planning and Design Guidance	13 Jun 86
86-14	Solar Applications	15 Oct 86
86-16	Direct Digital Control Heating Ventilation and Air Conditioning Systems	9 Dec 86
87-1	Lead Ban Requirements of Drinking Water	15 Jan 87
87-2	Volatile Organic Compounds	4 Mar 87
87-4	Energy Budget Figures (EBFs) for Facilities in the Military Construction Program	13 Mar 87
87-5	Utility Meters in New and Renovated Facilities	13 Jul 87
87-9	Prewiring	21 Oct 87
88-2	Photovoltaic Applications	21 Jan 88
88-3	Design Standards for Critical Facilities	15 Jun 88

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ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
88-4	Reliability & Maintainability (R&M) Design Checklist	24 Jun 88
88-6	Heat Distribution Systems Outside of Buildings	1 Aug 88
88-9	Radon Reduction in New Facility Construction	7 Oct 88
88-10	Prewired Workstations Guide Specification	29 Dec 88
89-2	Standard Guidelines for Submission of Facility Operating and Maintenance Manuals	23 May 89
89-3	Facility Fire Protection Criteria for Electronic Equipment Installations	9 Jun 89
89-4	Systems Furniture Guide Specification	6 Jul 89
89-6	Power Conditioning and Continuation Interfacing Equipment (PCCIE) in the Military Construction Program (MCP)	7 Sep 89
89-7	Design of Air Force Courtrooms	29 Sep 89
90-1	Built-Up Roof (BUR) Repair/Replacement Guide Specification	23 Jan 90
90-2	General Policy for Prewired Workstations and Systems Furniture	26 Jan 90
90-3	TEMPEST Protection for Facilities Change 1 Ref: HQ USAF/LEEDE Ltr dated 20 April 90, Same Subject	20 Apr 90
90-4	1990 Energy Prices and Discount Factors for Life-Cycle Cost Analysis	24 May 90
90-5	Fuel and Lube Oil Bulk Storage Capacity for Emergency Generators	26 Jul 90
90-6	Electrical System Grounding, Static Grounding and Lightning Protection	3 Oct 90
90-7	Air Force Interior Design Policy	12 Oct 90
90-8	Guide Specifications for Ethylene Propylene Diene Monomer (EPDM) Roofing	17 Oct 90
90-9	Fire Protection Engineering Criteria for Aircraft Maintenance, Servicing, and Storage Facilities	2 Nov 90
90-10	Commissioning of Heating, Ventilating, and Air Conditioning (HVAC) Systems Guide Specification	17 Oct 90
91-1	Fire Protection Engineering Criteria Testing Halon Fire Suppression Systems	2 Jan 91
91-2	High Altitude Electromagnetic Pulse (HEMP) Hardening in Facilities	4 Mar 91
91-3	Water Supply for Fire Protection	14 Jun 91

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ENGINEERING TECHNICAL LETTERS (ETL)

SECTION A - CURRENT ETLs

ETL Number	Title	Date Issued
91-4	Site Selection Criteria for Fire Protection Training Areas	14 Jun 91
91-5	Fire Protection Engineering Criteria - Emergency Lighting and Marking of Exits	18 Jun 91
91-6	Cathodic Protection	3 Jul 91
91-7	Chlorofluorocarbon (CFC) Limitation in Heating, Ventilating and Air-Conditioning (HVAC) Systems	21 Aug 91

SECTION B - OBSOLETE ETLs

No.	Date	Status
82-1	10 Nov 82	Superseded by ETL 83-10, 86-1, 87-4
82-3	10 Nov 82	Superseded by ETL 83-5, 84-2
82-4	10 Nov 82	Superseded by ETL 84-7
82-5	10 Nov 82	Superseded by ETL 84-1, 86-13, 86-14
82-6	30 Dec 82	Cancelled
82-7	30 Nov 82	Cancelled
83-2	16 Feb 83	Superseded by ETL 84-3
83-6	24 May 83	Cancelled
84-3	21 Mar 84	Cancelled
84-4	10 Apr 84	Superseded by ETL 86-7, 86-15, 87-5
84-5	7 May 84	Superseded by ETL 84-8, 86-11, 86-18, 88-6
84-6	Not Issued	Cancelled/Not Used
84-9	5 Jul 84	Superseded by ETL 88-7
88-5	2 Aug 88	Superseded by ETL 91-6
86-3	21 Feb 86	Superseded by ETL 86-4
86-6	3 Jun 86	Superseded by ETL 86-11, 86-18, 88-6
86-7	3 Jun 86	Superseded by ETL 86-15
86-12	3 Jul 86	Superseded by ETL 90-2
86-13	18 Aug 86	Superseded by ETL 86-14
86-15	13 Nov 86	Superseded by ETL 87-5
86-17	17 Dec 86	Superseded by ETL 89-6
86-18	18 Dec 86	Superseded by ETL 88-6
87-3	12 Mar 87	Superseded by ETL 87-6, ETL 88-5
87-6	21 Aug 87	Superseded by ETL-88-5
87-7	14 Oct 87	Superseded by ETL 89-1
Chg 1	30 Dec 87	Superseded by ETL 90-1
88-1	5 Jan 88	Superseded by ETL 89-2
88-7	24 Aug 88	Superseded by ETL 90-3, ETL 91-2
88-8	4 Oct 88	Superseded by ETL 91-7
89-1	6 Feb 89	Superseded by ETL 90-4
89-5		Issued as ETL 90-7